GenCorp
Aerojet

Propulsion Division

N91-28240

Technology Transfer Methodology

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Technology Transfer Methodology

- Introductory Comments
- Life and Death Issues
- Problems in Economics
- Barriers to Finding a Home
- Observations
- More Observations
- A Current Example
- Recommendations

Life and Death Issues

Conception to Maturity (Flight)

- Typically 8-12 Years
- Trend Is Wrong

There Are Few Survivors

- Juvenile Mortality Rates Are High (>90%)
- Many Deaths Are Warranted
- Some Deaths Are Untimely
- Technology Is Cheap, Development Costs Money
- Orphans Always Die
- Nurturing Parents Are Critical

Resurrection Is A Fact

- New Missions (HIPERTHIN)
- New Supporting Technology (E.P.)

Problems in Economics

Low Production Quantities Discourage Change

- Amortized Cost of Change Is High
- Products Have Long Lives
- Few New Systems
- No Payback for Incremental Improvements

Market for Propulsion Is Parochial (Fragmented), Short-Sighted

- No Significant Pooling of Interests, Resources
- Acquisition Costs Overshadow Life Cycle Costs

Observations

- Implementation Is Need Driven, Not Technology Driven
- Typical Drivers
  - Failure (STS Vernier Engines)
  - New Requirements (SDI - HIPERTHIN Injectors)
  - External Influences (Vendor Disappears, Environmental)

More Observations

Inhibitors to Using Improved Technology in Development

- NIH
- Caution (Perceived Risk)
- Ineffective Marketing (Technical Superiority Loses to Technical Adequacy + Superior Marketing)
- Ignorance (Not Stupidity)
- Lack of Vision (Requirements Growth Unrecognized)
- Funding (Off the Shelf Cheaper)

Technology Transfer – A Current Example

Technology – Ir/Re Chambers For Small Bipropellant Space Engines (0.5-1000 lbf)

Benefits – Improved Performance
5 lbf, + 25 sec Is
100 lbf, + 10-15 sec Is

– Longer Life (10X)

– Wider Margins

Technology Development

1984 – Present

LeRC Primary Funding Source
Also JPL, Aerojet IR&D, SBIR Contracts

Technology Application Opportunities

1987 – Proposed CRAF Mission

MM II Propulsion From FRG (MBB)

MBB 400N Engine Inadequate (I_s = 308)

JPL Funds Aerojet 400N Ir/Re Demo Engine

I_s = 323 sec

Duration = 15,000 sec (Funding Limited)

T_{wall} = 3500°F (800°F Margin)

Program Terminated

– "German Engine To Be Used"

– CRAF Slips, Lower Energy Requirements

Technology Application Status

1990 – MMII Propulsion

- FRG 400N Engine Being Replaced
- Ir/Re A Candidate If Readiness Can Be Demonstrated

– STS Vernier Engines

- Improved Life and Margin Chambers Being Considered
- Ir/Re A Strong Candidate

Assessment and Recommendations

- Positive Factors
  - Major Technology Improvement
  - Very Positive Results to Date
  - Concerned Parents (Byers at LeRC, Aerojet)
  - Broad Applicability With Payoff
- Negative Factors
  - Highly Fragmented Market (1's and 2's)
  - Currently Not Need Driven
- Recommendation
  - NASA Recognize and Fill Gap Between Code R Charter and Fragmented User Codes (i.e., Combine Needs)

Recommendations

- Goal - More Effective Use of New Technology
- Approach - Develop Co-Ownership of Technology
  (Minimize NIH, Ignorance, etc.)
- Technique - Co-Sponsorship of Technology
  (Code R vs. E, M, etc.)

Recommendations (Cont)

Co-Sponsorship of Technology

- Code R Budget
  - 1/3 Unrestricted "Blue Sky Technology"
  - 2/3 Restricted to Co-Signing, Co-Sponsorship With Other Codes
- Other Codes
  - Given Budget "Set-Aside" Equal to Code R Restricted 2/3, "Set-Aside" Budget Must be Spent in Code R with Co-Signing, Matching Code R Funds

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Recommendations (Cont)

- Benefits of "Co-Signed" Technology
  - User Code Has Ownership
  - User Code Has Input on Technology Direction
  - Code R Sees Substantial Budget Enhancement
  - Forces Continuing Technologist/User Dialog

- Drawbacks of Suggested Approach
  - Adds Complexity to Administration
  - Nothing Is as Simple as It Appears